An introduction to the COLORADO FUEL CELL CENTER

Governor's 2005 Tech Week
October 19, 2005
presented by
Dr. Robert J. Remick,
Executive Director, CFCC

CFCC
Colorado Fuel Cell Center

Funding for CFCC

- Support for the CFCC comes from the Governor's Office of Energy Management and Conservation (OEMC) using US DOE funding sources and from our co-funding partners:
  - Colorado School of Mines
  - Gas Technology Institute
  - National Renewable Energy Laboratory
  - Versa Power Systems, Inc.

CFCC
Colorado Fuel Cell Center

Located on the CSM Campus

The CFCC is located in the General Research Lab (GRL) on the Colorado School of Mines Campus.

CFCC
Colorado Fuel Cell Center

Our Three-Fold Mission

- Research and Development
- Education and Outreach
- Support for Commercialization

CFCC
Colorado Fuel Cell Center

Research and Development

- Provide leadership within the state in fuel cell technology development and application.
  - Foster the development of university-based R&D programs addressing product development issues
  - Provide independent research, testing, and product verification services

CFCC
Colorado Fuel Cell Center

R&D Capabilities (Beginning March '06)

- Materials and electrochemical technology R&D
- Performance and endurance studies
- Demonstration of complete multi-kilowatt systems

CFCC
Colorado Fuel Cell Center

Cell Testing up to 120 cm^2

Test stand purchased from Versa Power Systems

CFCC
Colorado Fuel Cell Center

Education and Outreach

- Provide opportunities for public education on the benefits of fuel cells
- Promote the development of fuel cell curriculums in colleges, universities, and trade schools to build a technically competent labor pool

CFCC
Colorado Fuel Cell Center

Support for Commercialization

- Assist in the formation of strategic alliances among Colorado developers and university research centers
- Serve as a nexus for information on applications and markets

CFCC
Colorado Fuel Cell Center

Colorado is the Place to Be

- High concentration of high-tech industries
- Skilled and well-educated workforce
- Wide range of environments for field testing
- Good early-adopter base for remote power
- Universities with well-respected R&D programs
- State government committed to clean environments and energy efficiency

CFCC
Colorado Fuel Cell Center

Colorado Businesses are Interested in Fuel Cells

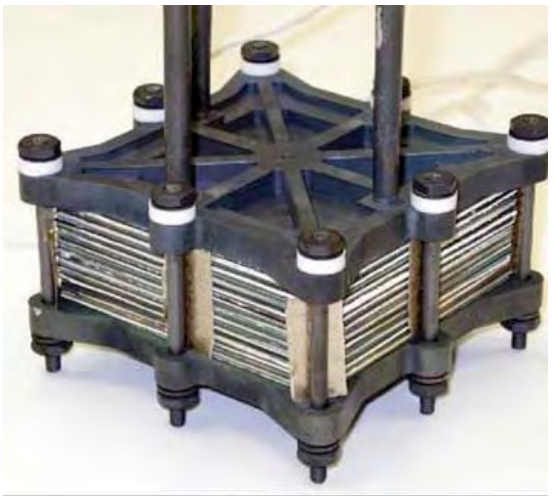
The 2005 *Fuel Cell Directory* lists 23 Colorado companies that are active in one or more aspects of development of fuel cells.

20 Watt Fuel Cell built by ITN Energy Systems & Mesoscopic Devices

CFCC
Colorado Fuel Cell Center

Colorado has Everything Needed to Grow a World-class Fuel Cell Industry

- Local Fuel Cell Developers
- Materials and Services Providers
- Finance & Management Consultants
- World-class Universities
- R&D Laboratories



Versa Power Systems
SOFC module

CFCC
Colorado Fuel Cell Center

Mesoscopic Devices (Bloomfield, CO)

75-Watt SOFC Generator

CFCC
Colorado Fuel Cell Center

Versa Power Systems (Golden, CO)

Prototype 2-kilowatt Residential Power System

Colorado Fuel Cell Center

Goals of CFCC Two-Year Plan

- Mission Centered R&D
- Industry Partnering
- Self-sustaining in 2-years
- Promote Education in Fuel Cell Technology
- Stimulate Significant Economic Development

CFCC
Colorado Fuel Cell Center

How will Colorado benefit?

- CFCC will assist in bringing more R&D dollars to the state via Colorado developers.
- As fuel cells appear in the Colorado market, there will be hundreds of high tech jobs in installation, maintenance and repair.
- Our ultimate goal is to encourage manufacturing of fuel cells within the state creating thousands of new jobs.

CFCC
Colorado Fuel Cell Center

Fuel Cells are coming to Colorado in many forms.

- Chemically rechargeable cell phones
- Power supplies for laptop computers
- Residential fuel cells and back-up power supplies
- Commercial-scale distributed generation power plants

CFCC
Colorado Fuel Cell Center

Fuel cells: more from less

- Generating Efficiency
  - Pressurized water nuclear reactor 32%
  - Coal burning power plant 40%
  - Combined Cycle Natural Gas 55%
  - Residential fuel cell 35% + heat
  - Commercial fuel cell 42% + heat
  - Advanced SOFC/turbine 70% + heat

CFCC
Colorado Fuel Cell Center

Heat generated locally can be used to offset fuel costs.

UTC Fuel Cells PC-25

Uses:

2100 SCF/hr NG

Produces:

200 kW electric (37%)

900,000 Btu/hr (40%)
water at 60°C

Saves $50,000 per year in fuel costs for heating hot water.

CFCC
Colorado Fuel Cell Center

High temperature technologies push efficiency to higher limits

FuelCell Energy
DCF-300

Uses

1920 SCF/hr NG

Produces

250 kW electric (47%)

300,000 Btu/hr (16%)
steam at 340°C

Use of co-generated heat saves up to $20,000 per year in fuel costs.

CFCC
Colorado Fuel Cell Center

Strong Foundation of Ongoing Collaborations

CFCC
Colorado Fuel Cell Center

CFCC Board of Advisors

- Professor Nigel Middleton, Executive Vice President, CSM
- Professor Robert Kee, George R. Brown Professor, CSM
- Ms. Susan Hock, Center Director, NREL
- Dr. Stanley Bull, Associate Director, Science & Technology NREL
- Dr. Robert Stokes, President, VPS
- Mr. William Barker, Director of Program Development, VPS
- Dr. Jerry Martin, President, Mesoscopic Devices, LLC

CFCC Executive Director

- Dr. Robert Remick, GTI

CFCC
Colorado Fuel Cell Center